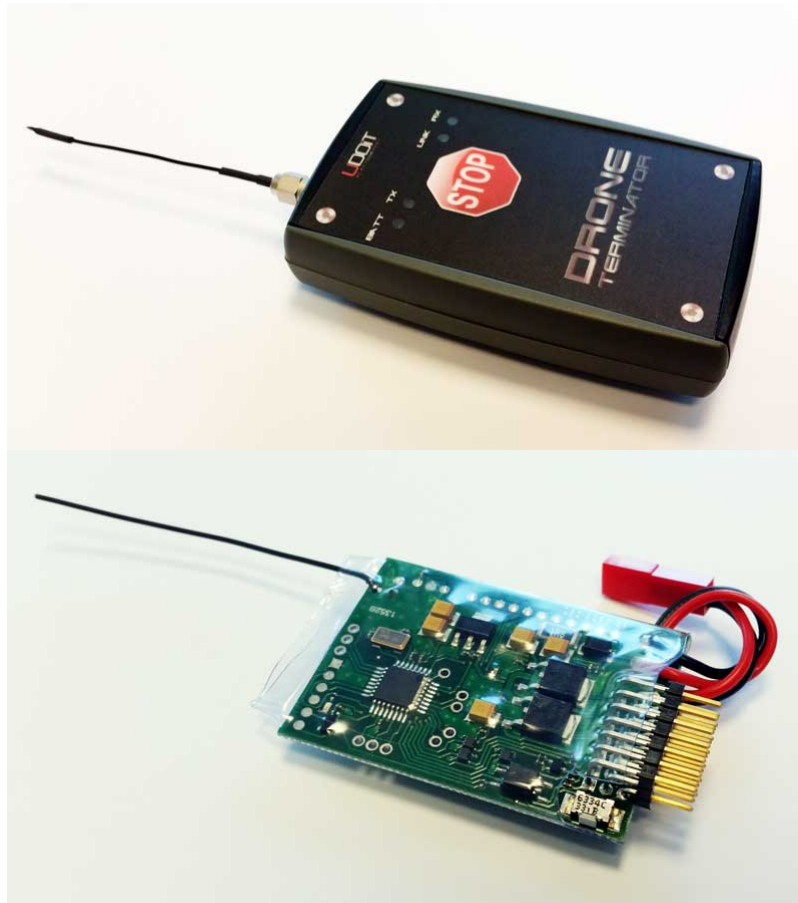


KIT LRT-869

Long Range Terminator 869 MHz

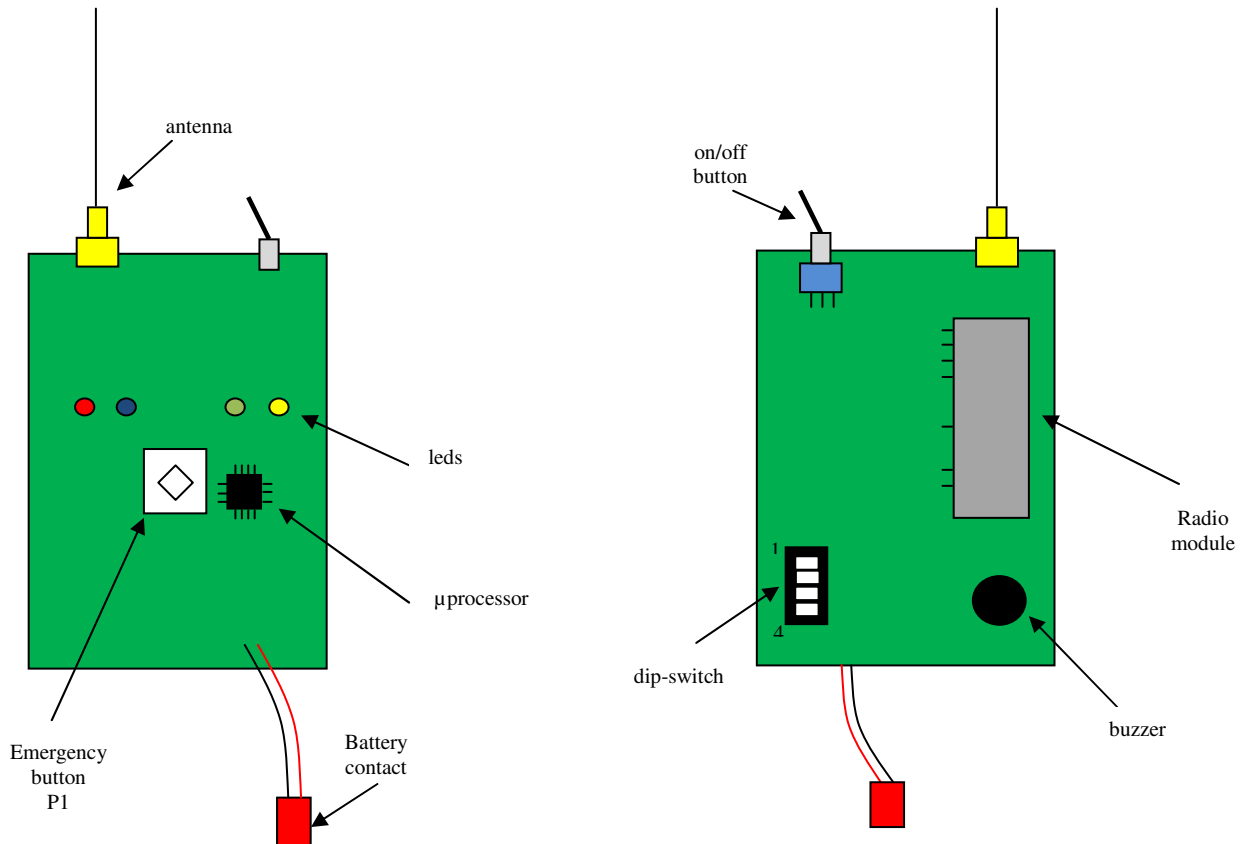
SAPR flight termination system



USER MANUAL

System comprises a MASTER unit (remote control) and SLAVE unit (installed on drone).
Radio communication between the two units occurs on 869 MHz bandwidth free from license payment and in compliance with European Rule CEPT 70-03.
Furthermore the radio communication is protected with encryption keys in order to avoid any hacking activity to terminate the flight.

MASTER Unit



Master Unit is a 68x55 mm board including Aurel radio transceiver RTX-869-LONG RANGE (max emitted power 500 mW).

Power supply is by a LiPo 2S battery.

Maximum voltage supply is 12V. The average consumption is 50 mA.

There are 4 leds:

1. **RED** LED – BATT: normally off, it blinks when battery goes down to 6,6V.
2. **GREEN** LED – LINK: it's on when MASTER gets keep-alive message from SLAVE. It's off when message is not received. It blinks if keep-alive is disabled by setting ON dip-switch 1.
3. **YELLOW** LED – RX: it's on if the SLAVE output is enabled, off if it's disabled.
4. **BLUE** LED – TX: on during the transmission of keep-alive message.

In case of battery discharge RED LED blinks and buzzer beeps.

Master open drain output reflects the GREEN LED (LINK) status.

Master has got 4 dip-switches which allow to set up both units functionality.

In particular dip-switches are used when the module is turned on to set the radio channel.

When turned on Master unit starts up a self-test: it beeps and all leds blink quickly in sequence.

Then it sets the radio channel according to dip-switch 4-3-2 configuration.

Radio channel is set according to the following table:

Dip-switch 4	Dip-switch 3	Dip-switch 2	Radio Channel
OFF	OFF	OFF	0
OFF	OFF	ON	1
OFF	ON	OFF	2
OFF	ON	ON	3
ON	OFF	OFF	4
ON	OFF	ON	5
ON	ON	OFF	6
ON	ON	ON	BINDING

By means of dip-switch 4-3-2 ON, the BINDING mode is triggered and Master and Slave are bound (see later specific paragraph).

Dip-switch 1 is used to disable the keep-alive message.

In particular you have:

dip-switch 1 = OFF: keep-alive ON

dip-switch 1 = ON: keep-alive OFF

It's possible to change dip-switch 1 (switching on and off keep-alive) even during normal operation.

Master reads the channel configuration ONLY at the start; it's not possible to change channel during operations. If you need to change channel, you must set dip-switch 4-3-2 according to the table above, turn off the unit and then turn it on again.

Master, after reading the channel set by dip-switch 4-3-2, starts up a procedure of CONNECTION by sending to the Slave information on the channel to be used. This feature allows to change the channel without accessing the Slave unit, which could be far from the Master or hard to reach.

During the CONNECTION procedure, LINK LED blinks quickly: this phase can last some seconds. Once the procedure is over, Master beeps 4 times with increasing tones to notify the successful connection.

Then, if dip-switch 1 is OFF, Master sends to Slave the keep-alive message every 1,5 seconds. Any time Master fails to get the acknowledgment from Slave it beeps and turn off LINK LED: a repeated beeping (at interval of 1,5 sec.) shows that the radio link is not reliable anymore.

By pushing P1 button the Slave Open Drain output is triggered and, after a programmable delay, the PWM output for parachute is activated too.

P1 emergency button can operate in 2 modes:

BISTABLE: Slave open drain output (and PWM) toggles any time P1 button is pressed.

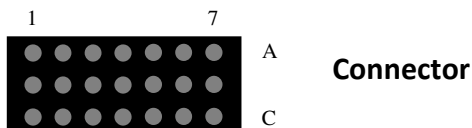
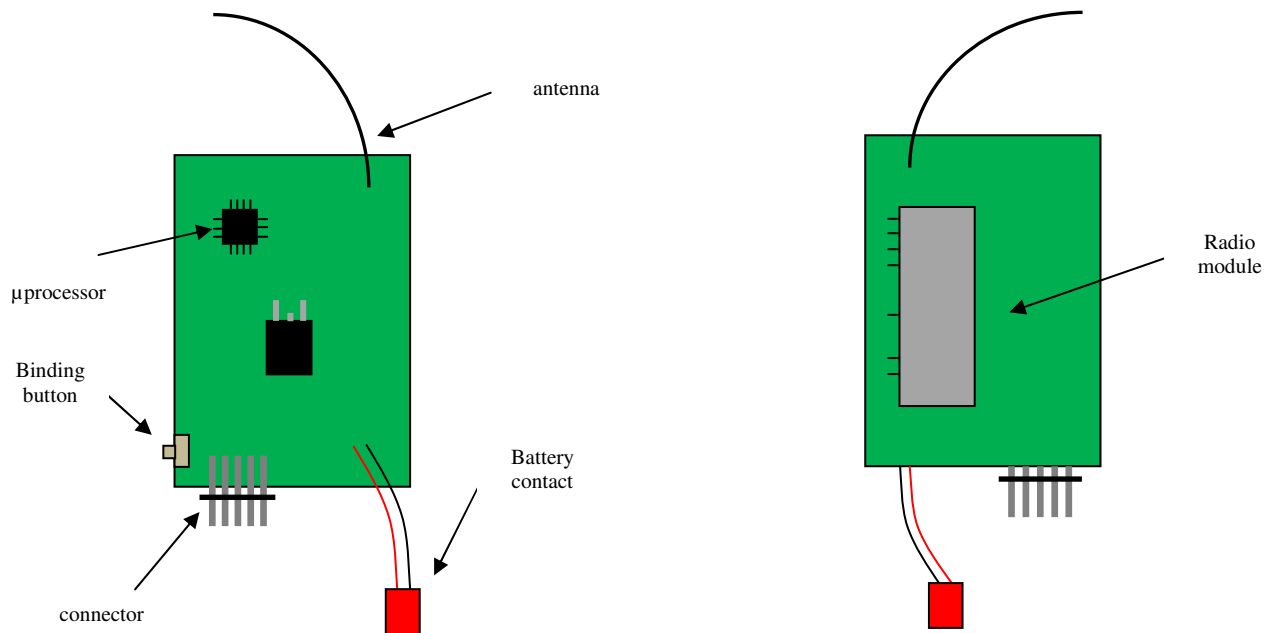
MONOSTABLE: Slave open drain output (and PWM) is on for a programmable time any time P1 button is pressed and then automatically turns off.

In case of MONOSTABLE mode, the activation time of Slave output (and PWM) is programmable with 0,1 sec. step, in the range from 0,1 sec. (min. pulse) to 1,5 sec. (max. pulse).

The delay of activation of parachute output is programmable with 0,1 sec. step, in the range from 0 sec. (no delay) to 1,5 sec. (max delay).

The operation mode settings (BISTABLE, MONOSTABLE), activation times and delay times are set in the BINDING phase.

SLAVE Unit



	1	2	3	4	5	6	7
A	NOT IMPLEMENTED	NOT IMPLEMENTED	Open Drain output	NOT IMPLEMENTED	Parachute servo output	NC	JUMPER A
B	NC	+5V	+5V	+5V	+5V	External +5V	JUMPER B
C	NOT IMPLEMENTED	GND	GND	GND	GND	GND	NC

Slave unit (equipped with the same radio module RTX-LONG RANGE 869 like the Master) is a 55 x 40 mm board, 20 grams weight, protected with a heat shrinkable tubing, to be on board of drone.

It can be supplied in two ways:

1. From 3S to 6S battery

In this case battery must be connected to JST connector available on the module (see diagram hereabove) e not connect anything to strip 6 and 7 of connector.

This way it's possible to connect servos up to 1A of continuous current and 2.2A peak current.

2. +5V regulated external power

In this case external power supply (typically a BEC) must be connected to terminal B (+5V) and C (GND) of the strip 6 as above described. Furthermore connect a jumper between terminal Jumper A and Jumper B of strip 7.

This way it's possible to drive servos with higher current consumption than those described before. BEC must be designed in according to servo that you want to drive.

Average consumption is 50 mA.

On board is available a push button for BINDING.

Once the board is power supplied and bound to Master, Slave unit is in reception mode waiting for the keep-alive message coming from the Master.

When the Slave gets this message it replies with an ACK message.

If it gets a termination message, after the P1 emergency button has been pressed on the Master unit, it activates the open drain and PWM output with timing set during BINDING phase.

BINDING

Every Master unit has got an unique code programmed in factory, while the Slave unit comes with no programmed code, but the latter gets it during this phase.

Before starting operations with units it is MANDATORY to execute BINDING.

To start BINDING phase follow the below steps:

- turn on the Slave by pressing and holding the button until LED is steady ON (led blinks at the start for self-test);
- keeping the Master unit off, set ON dip-switch 4-3-2, then turn on the unit
- after the self-test Master turns on all LEDs and waits for programming.

Programming occurs in 3 phases. You move from one phase to the next one by pushing the P1 button.

PHASE 1

You program the operation mode of Slave output: BISTABLE or MONOSTABLE.

This selection occurs by setting 4 dip-switches and pressing button P1.

If you set the 4 dip-switches OFF the mode is BISTABLE.

In all the other configurations mode is MONOSTABLE and activation time is set according to the following table:

Dip switch 4	Dip switch 3	Dip switch 2	Dip switch 1	MONOSTABLE activation time [seconds]
OFF	OFF	OFF	OFF	BISTABLE mode
OFF	OFF	OFF	ON	0,1
OFF	OFF	ON	OFF	0,2
OFF	OFF	ON	ON	0,3
OFF	ON	OFF	OFF	0,4
OFF	ON	OFF	ON	0,5
OFF	ON	ON	OFF	0,6
OFF	ON	ON	ON	0,7
ON	OFF	OFF	OFF	0,8
ON	OFF	OFF	ON	0,9
ON	OFF	ON	OFF	1,0
ON	OFF	ON	ON	1,1
ON	ON	OFF	OFF	1,2
ON	ON	OFF	ON	1,3
ON	ON	ON	OFF	1,4
ON	ON	ON	ON	1,5

When you press P1 button, Master turns off LED (RED LED) and moves to phase 2.

PHASE 2

You program the delay in Slave output (PWM) that activate parachute.

This selection occurs by setting again 4 dip-switches and pressing button P1.

Delay time is set according to the table below:

Dip switch 4	Dip switch 3	Dip switch 2	Dip switch 1	Delay time in parachute activation [seconds]
OFF	OFF	OFF	OFF	0 (no delay)
OFF	OFF	OFF	ON	0,1
OFF	OFF	ON	OFF	0,2
OFF	OFF	ON	ON	0,3
OFF	ON	OFF	OFF	0,4
OFF	ON	OFF	ON	0,5
OFF	ON	ON	OFF	0,6
OFF	ON	ON	ON	0,7
ON	OFF	OFF	OFF	0,8
ON	OFF	OFF	ON	0,9
ON	OFF	ON	OFF	1,0
ON	OFF	ON	ON	1,1
ON	ON	OFF	OFF	1,2
ON	ON	OFF	ON	1,3
ON	ON	ON	OFF	1,4
ON	ON	ON	ON	1,5



When you press P1 button, Master turns off another LED (GREEN LED) and moves to phase 3.

PHASE 3

In this phase it's possible to program the PWM signal REVERSE for parachute activation. This selection occurs by setting dip-switch 1 and pressing P1 button:
In particular you have:

dip-switch 1 = OFF: NORMAL
dip-switch 1 = ON : REVERSE

When you press P1 button, Master turns off all LEDs and starts up BINDING phase with Slave, blinking all LEDs simultaneously.
If the BINDING phase is successful:

- Master unit beeps 4 times with increasing tones;
- Slave unit makes LED blink and then gets back to normal operation mode (LED off).

Master unit stays in BINDING phase until it's turned off (all LED blink simultaneously).

Warning! When the Master unit is switched off, set dip-switch 4-3-2 according to the desired channel and set dip-switch 1 OFF if you want keep-alive on.

Note. During the BINDING phase, Master sends DRONE ID, HASH keys, encryption keys and operation modes to the Slave. For security reason the emitted power of both the units is decreased to minimum (8 dBm). Thus the two units should be close each other.

Moreover BINDING phase should be executed in a secure area. In any case in order to grant a relevant security, Master unit randomly generates new HASH keys every time it connects to Slave.